ESG Investing in China Stock Market: An Empirical Study Based on Three-factor Model

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Abstract: Given the escalating prominence and swift advancement of ESG investments on a global scale, the feasibility of attaining a specified return while accounting for social responsibility has emerged as a pivotal concern garnering investors' scrutiny. As one of the earliest applied investment strategies, the negative screening strategy has been proven effective worldwide. This study utilizes a sample of 2414 stocks with ESG ratings for five consecutive years (2018-2021) from the Wind database and employs the Fama-French three-factor model to measure the impact of score-based filters on passive investment in the vast and distinctive Chinese stock market. Empirical evidence indicates that by excluding stocks of low best-in-class ESG scores, it is possible to increase the average ESG performance without deterioration of investors' risk-adjusted excess return. The findings demonstrate the validity of the three-factor model and the significance of ESG-related indicators as an implicit factor in investment strategy within China stock market.

Keywords: ESG investing, negative screening, three-factor model, China stock market

1. Introduction

In recent years, environmental, social, and governance(ESG) considerations have emerged as pivotal subjects within the realms of finance and corporate governance. The ESG investment concept refers to integrating three principal elements: environmental stewardship, social responsibility, and corporate governance, into the process of investment decision-making, emphasizing the pursuit of both financial returns and non-financial factors affecting the company's sustainable development such as environmental, social, and corporate governance returns. In the global market, according to the Global Sustainable Investment Alliance(GSIA) statistics, the scale of ESG Asset Management reached one-third of the global AUM as early as 2012 and is continuously expanding. As of the end of June 2023, the overall global sustainable funds are demonstrating a positive growth trend, with 7426 sustainable funds issued, raising $2.834 trillion and achieving consecutive growth since the third quarter of 2022.

In China's capital market, ESG investment has also received widespread attention. ESG investment is highly correlated with the "dual carbon " [1], which is the short name of carbon neutrality and emission peak. The Chinese government proposed the "dual carbon" goal in September 2020, which was included in the 2021 Report on Work of the State Council. On the one hand, investors' views on environmental protection are gradually shifting from negative risk avoidance to positive social responsibility, and they are paying high attention to green investments. On the other

hand, many financial institutions have begun introducing ESG factors, and regulatory authorities are gradually incorporating ESG into the regulatory system. Policy guidance has become an important driving force for the effective implementation of ESG concepts. In 2018, for example, the China Securities Regulatory Commission issued the "Code of Corporate Governance for Listed Companies", which stated that listed companies should disclose environmental information and fulfill social responsibility such as poverty alleviation by laws, regulations, and relevant department requirements. From 2018 to the end of June 2023, a total of 477 ESG-themed public funds with keywords such as "ESG," "social responsibility," and "green" were issued in China. In terms of the cumulative number of funds issued, the proportion of environmental protection-themed funds is 43.2%, followed by pure ESG-themed funds at 23.5%. As of the end of June 2023, the scale of China's ESG public funds exceeded 590 billion yuan. However, compared to the international capital markets, ESG in China is still in its early stages of development, and domestic companies lack sufficient disclosure of ESG information. There remains a considerable distance to the establishment of the ESG rating system, and the investment landscape based on ESG indicators has not yet been fully embraced by investors.

From the perspective of investors, ESG integration, negative screening, and active shareholders are the three most popular strategies in the overseas ESG investment market. Due to its straightforward and convenient characteristics, the negative screening strategy was more favored by investors of small and medium-sized in the early stage. The simplest and still most popular method is to exclude "sin" industries such as alcohol, tobacco, or gaming[2]. Another method is to use the company's ESG scores or ratings for negative screening. Research indicates that excluding companies with low ESG ratings directly can lead to the omission of firms that are involved in sustainable practices but situated in industries with subpar scores from ESG investment portfolios. This may place investors at a disadvantage by narrowing down the selection to a subset (Statman and Glushkov 2009). One way to address this issue consists of rescaling the score of a firm based on the scores of peers within the same industry, which promotes positive screening and is referred to as the best-in-class approach. Under this circumstance, investors limit themselves to stocks with excellent social responsibility ratings, resulting in maximum abnormal returns[3].

However, most researches on the negative screening method for ESG investment focus on the global market. As more companies are excluded from ESG investment portfolios, the weights of companies in the U.S. and emerging markets will decrease, while more European companies will be include[4]. Taking into account the uniqueness of China stock market, including prominent systemic risks, a substantial presence of small and medium-sized investors, and the market's efficiency heavily reliant on information disclosure by listed companies, we wonder whether the application of negative-screening investment strategy by excluding companies with low best-in-class ESG scores equally effective in the China's market. Since this area is currently lacking, this paper focuses on China's market, applying the Fama-French three-factor model to analyze this preferred investment strategy among small and medium investors and whether it can achieve excess returns. The significance of the study lies in First, this study can provide a straightforward and potentially rewarding investment strategy for small and medium investors who often lack professional investment knowledge and resources, compared to institutional investors, as well as prefer simple investment strategies. Second, this study can help validate ESG scores as a factor in investment strategy and test their influence on excess returns. Generally speaking, if an investment strategy selecting high ESG-score companies can achieve excess returns, it will demonstrate the importance and effectiveness of ESG factors in investment decisions. Third, by proving that an investment strategy selecting high ESG-score companies can bring excess returns, it can further promote corporate attention to sustainable development and social responsibility, thereby attracting more funds into these areas. Finally, the research can also explore and verify the effectiveness of using a three-factor model to analyze and explain the stock performance of different ESG-score companies in China stock market.

2.   Literature Review

2.1.   ESG investment

ESG investment refers to the integration of ESG principles into investment research and practice. It involves examining the long-term development potential of companies through the environmental, social, and governance dimensions, on top of traditional financial analysis, to find investment targets that create not only shareholder value but also societal value that has sustainable growth potential. The concept of responsible investing, which pursues long-term value while considering both economic and social benefits, is relatively prevailing at present. More and more investors are incorporating ESG factors into their investment decisions to assess companies' long-term value and sustainability.

It is sometimes difficult to balance high investment returns with making a positive impact on the environment and society in practical application. One explanation is that ESG investing is a subset of the market, therefore exhibiting lower diversification capability. Some investors focused on sustainable development conduct negative screening based on certain ethical criteria and may exclude investment portfolios containing stocks of companies with negative externalities. Zechner developed a balancing model in which exclusive ethical investing results in fewer green investors holding stocks of polluting companies, keeping the stock prices of "sin companies" at lower levels, and increasing the capital cos[5]. However, as demonstrated by Adler and Kritzman in simulation exercises, excluding certain companies inevitably brings some costs, and so-called "sin stocks" (typically alcohol, tobacco, and gambling) historically have outperformed[6] and delivered returns higher than other stocks[7]. Another explanation is that sustainability sacrifices short-term growth. Research also indicates that the advantages of stocks of companies with high social responsibility scores are largely offset by the disadvantages of avoiding stocks of certain companies, enabling investors to achieve higher returns by investing in stocks with high social responsibility scores without avoiding any stocks[2]. Derwall et al. proved that the performance of a stock investment portfolio comprised of high ecological efficiency score companies in the US from 1995 to 2003 outperformed those with low scores, and this distinctness cannot be explained by differences in market risk, investment style, or industry risk[8]. Similar results were further confirmed by Kempf and Osthoff, where stocks of companies with overall higher rankings in indicators including community, diversity, employee relations, environment, human rights, and products performed better than those with lower rankings[3].

2.2.   Factor Model

Multiple evaluation models for security portfolios continue to emerge and undergo verification and improvement. The factor model explains the returns of a fund, with its evaluation method decomposing the returns into multiple factors such as market risk factors, industry factors, style factors, etc. to better analyze the fund's performance. Sharpe's CAPM model explains the relationship between the risk and return of securities with the core assumption that investors are rational and all investors have the same expected returns and risk preferences, which form a framework of an equilibrium market where asset prices depend on the equilibrium prices of the market[9]. Based on total risk, Sharpe (1966) proposed the Sharpe ratio; based on systematic risk, Treynor (1965) proposed the Treynor index; with risk adjustment, Jensen (1968) proposed the Jensen index to measure excess returns. These classic indices have been widely used in portfolio investment, and fund performance evaluation. Scholars have conducted innovative research based on these various classic single-factor models and their derivative indices. Studies have shown that many anomalies cannot be explained by CAPM while those can be well explained by indicators such as the inverse of the price-

to-earnings ratio, financial leverage, book-to-market ratio(PB), and stock market value. Fama and French selected stocks traded on the NYSE, AMEX, and NASDAQ from 1963 to 1990 (excluding financial stocks) as samples. Through studying the relationship between factors and the average stock returns, they ultimately found that market return rate, market value, and PB could well explain stock returns, proposing a three-factor asset pricing model, considering the influence of market risk (β), size factor (SMB), and book-to-market ratio (HML). Carhart added the momentum factor (MOM) on this basis, forming a four-factor mode[10]. In 2015, Fama and French found that the strength of a company's profitability and conservatism as well as the aggressiveness of investment style can directly and effectively explain stock returns, and these two factors were incorporated into the original three-factor model, expanding to form the Fama-French five-factor asset pricing model[11]. Subsequently, scholars continuously added new factors based on actual situations, and regression models of various factors gradually emerged.

Based on the introduction of the Fama-French three-factor model, an increasing number of scholars have started to research and demonstrate China's emerging market. Shi Yuyou et al. confirmed that the stock's D/E (debt-to-equity ratio), value factor, and company size should be inevitable factors affecting stock investment besides the former facto[12]. Liu Weiqi et al. researched China's A-share data and found that the three-factor model was effective based on the intercepts all statistically indistinguishable from zero[13]. In the process of applying the Fama-French three-factor model to study China's A-share market, the effectiveness was validated, yet certain limitations were also discerned. Scholars have begun to explore and expand the three-factor model in response to the situation of China stock market. Tian Lihui et al. found that the systematic risk and market value size effect is prominent while the HML effect is not significant. Moreover, investors lack sufficient concern for the growth of listed companies[14]. By adding the turnover rate and trading volume factor to the three-factor model, it was found that they have a significant negative impact on returns, which is particularly significant in small-cap stocks. Xia Yu's study according to the 2015-2020 market validated the applicability of the three-factor model in the A-share market in China and pointed out that the four-factor expanded model with the addition of the company growth factor provided a more robust explanatory framework than the original three-factor model. This indicates that companies with high levels of growth can indeed bring return premiums[15]. Some scholars attempted to include ESG factors as additional factors in the five-factor model, while empirical results show that this cannot effectively explain investment performance[16], which may be due to the significant environmental performance of green investment funds being lower than financial performance[17].

3. Methodology

Based on the "best-in-class" approach, the study constructs average ESG scores calculated through Wind ESG score, which is more scientifically applicable to Chinese companies by referencing the architecture of international mainstream ESG systems, integrating with China's capital market and regulatory policies. We accurately evaluate the screening effects by constructing a series of portfolios that exclude companies with the 1% lowest scores, the 2% lowest scores, etc., up to the 50% lowest scores. The portfolios are based on the relative capitalization of the remaining companies. The primary goal of this study is to assess the consistency of the passive portfolio performance constructed based on ESG standards from multiple dimensions such as industry, ESG standards, and risk factor exposures. For comparability purposes, we considered all portfolios in China's stock market from 2018 to 2022 and the market fit of the Fama-French three-factor model presented in this paper serves as the basis for testing market efficiency. The degree of impact ESG scores affecting portfolio performance is determined by the intercept estimated from the time series regression of the three-factor model.

3.1.   Construction of ESG score

To mitigate the exclusion of companies engaged in sustainable activities but belonging to industries with below-average scores, this paper adjusts the scores of companies based on the scores of their peers within the same industry aiming to control industry effects, this method promotes positive screening. We calculate the difference between the ESG score of each company and the industry average score as the best-in-class industry-adjusted average score. In this "best-in-class" approach, investors select the best companies in each industry. Research has found that portfolios constructed by the best-in-class method generate higher risk-adjusted performance compared to those using negative screening.

3.2.   Construction of Fama-French three-factor model

The model builds upon the CAPM model by incorporating the size (SMB) and value (HML) factors, addressing the limitations of the CAPM model in explaining excess returns. The model expresses the excess return of a stock (or portfolio) as a function of the market excess return, size, and book-to-market factors,

$$R_{it} - R_{Ft} = \alpha_i + b_i(R_{Mt} - R_{Ft}) + s_i SMB_t + h_i HML_t + \varepsilon_{it}$$

Where R_{it} ions average monthly return of portfolio i, R_{Ft} is risk-free rate observed each week, R_{Mt} is expected market return, $(R_{Mt} - R_{Ft})$ is the market factor, SMB_t is the size factor, also known as the market value factor, HML_t is the book-to-market factor, also known as the value factor, b_i, s_i and h_i are the exposures of portfolio i to these three factors, representing the sensitivity of the stock to each factor, ε_{it} is the mean-zero residual series, α_i is the excess return that cannot be explained by any of the factors in the model.

The regression coefficients b_i, s_i, h_i represent the risk loadings of the market, size, and PB factors, respectively. For example, if the s value of the small-size portfolio is greater than that of the large-size portfolio, it indicates that the small-size portfolio has higher risk than the large one. Similarly, if the h value of the high PB is greater than that of the low portfolio, it suggests that the high PB portfolio has a higher risk than the low one.

Based on the three-factor model, the study divided the sample into 6 groups according to the size and PB factors. Specifically, the sample stocks were first divided into large (B) and small (S) groups by their market capitalization on a weekly basis. Each group was then further divided into high (H), medium (M), and low (L) subgroups by their PB, with proportions of 30%, 40%, and 30% respectively. This resulted in 6 portfolios: SL, SM, SH, BL, BM, and BH. The weekly returns of these six portfolios were computed, weighted by the stocks' free-float market capitalization.

$$SMB = \frac{1}{3}(SH+SM+SL) - \frac{1}{3}(BH+BM+BL)$$

$$HML = \frac{1}{2}(SH+BH) - \frac{1}{2}(SL+BL)$$

After the factors calculation progresses, SMB averages across various BE/ME scenarios, eliminating the BM factor and focusing solely on the contribution of the size factor to the portfolio's excess returns. HML averages across various ME situations, excluding the size factor, and considers only the differences in portfolio returns caused by variations in the PB ratio factor.

According to the precise pricing model theory, if the regression intercepts (Jensen's alphas) of the portfolios constructed by excluding different proportions of low ESG-scored firms are not significantly different, it would suggest that corporate ESG performance does not affect returns.

Conversely, it indicates that corporate ESG performance has an impact on returns. In this part, the study examines whether and how ESG ratings affect abnormal returns, and further tests for statistically significant differences in Jensen's alphas between high-ESG and low-ESG investment portfolios, to investigate the impact of corporate ESG performance on stock investment returns.

3.3. Data

The study utilizes ESG data from the Wind database, selecting stocks in China with ESG scores spanning from 2018 to 2022, excluding ST, *ST, PT, and those with significant data gaps, resulting in a sample of 2,414 stocks. The weekly average return R_{Mt} is derived from the Wind database, using the mean of daily returns; the risk-free rate R_{Ft} uses the annualized weekly average of the Shanghai Interbank Offered Rate; the market return R_{it} is based on the return of the CSI 300 Index. Firm size is measured by free-float market capitalization from the Wind database, and PB is calculated using book equity and total equity data from the same data source.

4. Result

4.1. Descriptive Statistics

The study constructs portfolios by excluding companies with the lowest industry-adjusted average ESG scores. The descriptive statistics in Table 1 show that when excluding the bottom 10%, 25%, and 50% of companies by ESG score, the industry-adjusted average ESG score increases by 0.120, 0.152, and 0.275, respectively. However, the average returns of the value-weighted portfolios do not increase as more low-scoring stocks are excluded, and the variances across the different portfolios are relatively similar. This is consistent with the finding that "sin stocks" tend to have higher expected returns than their peer[7].

Table 1: Descriptive statistics: performance of portfolios based on industry-adjusted average ESG score.

Var Name	Avg_score	Obs	Mean	SD	Min	Median	Max
0% excl.	0.100	240	0.267	2.524	-8.824	0.437	8.667
10%exc.	0.220	240	0.251	2.514	-9.021	0.415	8.577
25%exc.	0.372	240	0.235	2.509	-9.078	0.433	8.433
50%excl.	0.647	240	0.225	2.520	-9.443	0.372	8.087

The descriptive statistics in Table 2 show that the size factor has a mean of -0.001 for the full sample, indicating that larger firms have higher returns. When excluding the bottom 10%, 25%, and 50% of companies by ESG score, the size and value factors both have negative means, suggesting that larger firms and lower-valued firms achieve higher returns. Additionally, the mean of the value factor is higher than that of the size factor after the screening, implying that the value premium is greater than the size premium.

Table 2: Descriptive statistics: performance of portfolios based on factors.

	SMB	HML	SMB	HML	SMB	HML	SMB	HML
Mean	-0.001	-0.026	-0.001	-0.022	-0.001	-0.025	-0.001	-0.024
SD	0.02	0.104	0.02	0.103	0.02	0.104	0.021	0.106
Min	-0.076	-0.376	-0.077	-0.394	-0.077	-0.373	-0.082	-0.372
Max	0.05	0.261	0.049	0.263	0.052	0.263	0.058	0.274

4.2. Regression

Table 3 indicates that the excess return rate in the full data set is 1.075% (2.88), while for the three portfolios that exclude the bottom 10%, 25%, and 50% of stocks based on ESG ratings are 1.267% (3.48), 1.611% (4.25), and 2.790% (5.98), respectively. The results show that the return rate without considering ESG is lower than the average level when ESG ratings are considered. As the exclusion proportion increases, the excess return rate exhibits an upward trend. Overall, excluding more low-scoring companies allows investors to improve the ESG score of their investment portfolios without deteriorating risk-adjusted performance.

Table 3: Factor exposure of portfolios based on industry-adjusted average ESG score.

	(1) 0%excl.	(2) 10%excl.	(3) 25%excl.	(4) 50%excl.
α	1.075***	1.267***	1.611***	2.790***
	(2.88)	(3.48)	(4.25)	(5.98)
b	0.917***	0.909***	0.932***	0.984***
	(83.51)	(93.71)	(89.89)	(70.09)
s	31.134***	27.884***	31.233***	40.697***
	(17.76)	(13.50)	(12.29)	(9.21)
h	-2.244	-4.970**	-5.667**	-0.973
	(-1.29)	(-2.20)	(-2.14)	(-0.23)
R^2	0.968	0.976	0.975	0.967
Adj. R^2	0.97	0.98	0.98	0.97
F	2381.379	3151.862	3109.998	2297.751

Furthermore, the market capitalization factor is significantly positively correlated with the returns of portfolios, irrespective of ESG ratings. This also indicates that large-cap stocks have more investment value than low-cap stocks. The book-to-market ratio(BM) and PB are inversely related. Therefore, BM is negatively correlated with the returns of listed companies, which also indirectly explains the positive relationship between the PB and returns, and a high PB to some extent indicates that the listed company is operating well and has development potential as well as investment value. In summary, the empirical test of the Fama-French three-factor model on China's A-shares Market finds that the ESG performance of listed companies is one of the factors affecting portfolio returns.

4.3. Robustness Test

According to the regression results, a preliminary conclusion was drawn that there is a positive relationship between ESG and stock investment. By excluding companies with relatively low

industry-adjusted ESG scores, excess returns can be obtained through ESG investment. This section will test the robustness of the results by replacing the dependent variable.

The average return of companies with the same ESG rating to some extent reflects the return level, while the level of individual companies cannot affect the average level of companies under that rating. Therefore, this paper uses the quarterly average return excluding the company's return as an alternative variable for the value-weighted weekly return of listed companies under the same ESG rating. The results after replacing the dependent variable (Table 4) show that the returns of the ESG investment portfolios excluding 0%, 10%, 25%, and 50% of the low-scoring ESG stocks are 1.959%, 2.153%, 2.354%, and 2.890% respectively. The investment portfolios formed by excluding different percentages of low-scoring ESG stocks all achieved higher returns than the portfolios that did not consider ESG factors, consistent with the previous results.

Table 4: Robustness test.

	(1) 0%excl.	(2) 10%excl.	(3) 25%excl.	(4) 50%excl.
α	1.959***	2.153***	2.354***	2.890***
	(24.41)	(30.38)	(29.45)	(27.10)
b	0.928***	0.918***	1.008***	1.241***
	(39.19)	(48.34)	(46.05)	(38.68)
s	109.418**	106.497***	125.905***	184.807***
	(28.96)	(26.35)	(23.45)	(18.30)
h	-9.360**	-8.630*	-10.471*	-4.805
	(-2.50)	(-1.95)	(-1.87)	(-0.49)
R^2	0.896	0.935	0.922	0.873
Adj.R^2	0.89	0.93	0.92	0.87
F	677.663	1126.532	929.827	539.024

5. Discussion

The purpose of this study is to investigate whether excluding stocks with low best-in-class industry-adjusted average scores can generate higher excess returns for investors in the China stock market. We expected that excluding more low-scoring stocks would lead to higher returns for investors. The results of this study show that the investment portfolios constructed by excluding more low-ESG-scored stocks indeed achieved higher risk-adjusted excess returns, supporting the hypothesis.

These findings are consistent with the conclusions of previous studies, which suggest that incorporating ESG considerations into passive investment strategies can improve ESG performance without compromising risk-return tradeoffs[4] as well as the conclusion of "doing good while doing well" [2]. While the exclusion of low-scoring companies has been discussed globally, its feasibility in China stock market has not been empirically tested and this study provides empirical evidence using the well-established three-factor model, which is valuable under the circumstance of the rapid rise of ESG principles and the government's efforts to establish a comprehensive ESG evaluation system in China. However, given that the data used in this study does not fully cover China stock market, the Wind ESG index does not yet have complete coverage of listed companies, and certain companies exhibited gaps or omissions in their ESG data during the period from 2018 to 2022. Additionally, this study only examined the effect of excluding low-scoring stocks on excess returns,

without further investigating the underlying mechanisms of how ESG factors influence portfolio performance.

Future research could contemplate the following directions: 1) Expanding the sample as the ESG scoring system in China becomes more comprehensive; 2) Employing multiple indicators or factors, such as book-to-market ratio, SMB, and HML, to more accurately assess and predict the risk and return of investment portfolios; 3) Exploring the mechanisms through which ESG scores affect the expected returns of portfolios.

6. Conclusion

The objective of this study is to investigate the efficacy of an ESG investment approach utilizing negative screening within the context of China stock market. To accomplish this goal, the research selects samples comprised of companies with ESG scores spanning from 2018 to 2022 and employs the Fama-French three-factor model for empirical testing. The results verify that this strategy can effectively improve investors' excess returns, which suggests that ESG ratings serve as an implicit factor in investment strategies and have certain validity in China stock market, filling the gap in the application of ESG investments based on negative screening in this large and distinctive market. The outcome provides a simple and feasible investment strategy for small and medium-sized investors and promotes enterprises' attention to sustainable development and social responsibility, which facilitates the inflow of more capital into ESG areas, thereby supporting the promotion of the sustainable development concept.

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